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THE LAW OFFICES OF JOHN C. SCOTT, LLC
c/o PORTFOLIO IP
P.O. BOX 52050
MINNEAPOLIS, MN 55402

EXAMINER	
VIGUSHIN, JOHN B	

ART UNIT	PAPER NUMBER
2841	

DATE MAILED: 12/16/2004

Please find below and/or attached an Office communication concerning this application or proceeding.

Office Action Summary	Application No. 10/623,319	Applicant(s) FRANCA-NETO ET AL.
	Examiner John B. Vigushin	Art Unit 2841

-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address --

Period for Reply

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE 3 MONTH(S) FROM THE MAILING DATE OF THIS COMMUNICATION.

- Extensions of time may be available under the provisions of 37 CFR 1.136(a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
- If the period for reply specified above is less than thirty (30) days, a reply within the statutory minimum of thirty (30) days will be considered timely.
- If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133). Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

Status

1)☒ Responsive to communication(s) filed on *19 July 2003*.

2a)☐ This action is **FINAL**. 2b)☒ This action is non-final.

3)☐ Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11, 453 O.G. 213.

Disposition of Claims

4)☒ Claim(s) *1-43* is/are pending in the application.

4a) Of the above claim(s) _____ is/are withdrawn from consideration.

5)☒ Claim(s) *11-16,29-32 and 41-43* is/are allowed.

6)☒ Claim(s) *1,2,4,5,7,9,17-22,24,26,27 and 33-40* is/are rejected.

7)☒ Claim(s) *3,6,8,10,23,25 and 28* is/are objected to.

8)☐ Claim(s) _____ are subject to restriction and/or election requirement.

Application Papers

9)☐ The specification is objected to by the Examiner.

10)☒ The drawing(s) filed on *19 July 2003* is/are: a)☒ accepted or b)☐ objected to by the Examiner.

Applicant may not request that any objection to the drawing(s) be held in abeyance. See 37 CFR 1.85(a).

Replacement drawing sheet(s) including the correction is required if the drawing(s) is objected to. See 37 CFR 1.121(d).

11)☐ The oath or declaration is objected to by the Examiner. Note the attached Office Action or form PTO-152.

Priority under 35 U.S.C. § 119

12)☐ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).

a)☐ All b)☐ Some * c)☐ None of:

1.☐ Certified copies of the priority documents have been received.

2.☐ Certified copies of the priority documents have been received in Application No. _____.

3.☐ Copies of the certified copies of the priority documents have been received in this National Stage application from the International Bureau (PCT Rule 17.2(a)).

* See the attached detailed Office action for a list of the certified copies not received.

Attachment(s)

1) ☒ Notice of References Cited (PTO-892)
2) ☐ Notice of Draftsperson's Patent Drawing Review (PTO-948)
3) ☐ Information Disclosure Statement(s) (PTO-1449 or PTO/SB/08) Paper No(s)/Mail Date _____.
4) ☐ Interview Summary (PTO-413) Paper No(s)/Mail Date. _____ .
5) ☐ Notice of Informal Patent Application (PTO-152)
6) ☐ Other: _____.

DETAILED ACTION

Rejections Based On Prior Art

1. The following references were relied upon for the rejections hereinbelow:

Edvardsson et al. (6,342,869 B1)

Lawrence et al. (US 5,936,584)

Pennisi et al. (US 5,313,365)

Miyazaki et al. (US 6,335,669 B1)

Moore et al. (US 5,666,272)

Claim Rejections - 35 USC § 102

2. The following is a quotation of the appropriate paragraphs of 35 U.S.C. 102 that form the basis for the rejections under this section made in this Office action:

> A person shall be entitled to a patent unless –
>
> (b) the invention was patented or described in a printed publication in this or a foreign country or in public use or on sale in this country, more than one year prior to the date of application for patent in the United States.

3. Claims 17, 24, 27, 33 and 34 are rejected under 35 U.S.C. 102(b) as being anticipated by Moore et al.

As to Claim 17, Moore et al. discloses, in Fig. 5, a microelectronic device including: a package 16 having an upper side and a lower side; and at least one microelectronic die 18 having wireless circuitry therein (col.6: 66-col.7: 12) mounted to the upper side of package 16; wherein the lower side of package 16 includes a plurality of terminals 22 to couple package 16 to a circuit board (col.3: 47-50) and the upper side of package 16 includes at least one terminal 26a,b to couple the microelectronic device to an external antenna 56 in upper module 14 (col.4: 50-56; col.6: 65-66); an antenna interface circuit 54 in the upper module 14 to provide an interface between the

microelectronic device and an antenna 56, the antenna interface circuit 54 having at least one terminal 32a-d that is connected to the at least one terminal 26a-d on the upper side of the package.

As to Claim 24, Moore et al. further discloses that antenna interface circuit 54 includes at least one antenna 56 integrated therein (col.6: 55-57 and 65-66).

As to Claim 27, Moore et al. further discloses that the plurality of terminals 22 on the lower side of package 16 includes a ball grid array (Fig. 5; col.4: 20-22 and 41-43).

As to Claim 33, Moore et al. discloses, in Fig. 5: a package 16 having an upper side and a lower side; and at least one microelectronic die 18 having wireless circuitry therein (col.6: 66-col.7: 12) mounted to the upper side of package 16; wherein the lower side of package 16 includes a plurality of terminals 22 to couple package 16 to a circuit board (col.3: 47-50) and the upper side of package 16 includes at least one terminal 26a-d to couple the microelectronic device to an external antenna 56 in upper module 14 (col.4: 50-56; col.6: 65-66).

As to Claim 34, Moore et al. further discloses that microelectronic die 18 has both digital processing circuitry and wireless transceiver circuitry located therein (col.6: 67-col.7: 3).

Claim Rejections - 35 USC § 103

4. The following is a quotation of 35 U.S.C. 103(a) which forms the basis for all obviousness rejections set forth in this Office action:

> (a) A patent may not be obtained though the invention is not identically disclosed or described as set forth in section 102 of this title, if the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the

> **invention was made to a person having ordinary skill in the art to which said subject matter pertains. Patentability shall not be negatived by the manner in which the invention was made.**

5. This application currently names joint inventors. In considering patentability of the claims under 35 U.S.C. 103(a), the examiner presumes that the subject matter of the various claims was commonly owned at the time any inventions covered therein were made absent any evidence to the contrary. Applicant is advised of the obligation under 37 CFR 1.56 to point out the inventor and invention dates of each claim that was not commonly owned at the time a later invention was made in order for the examiner to consider the applicability of 35 U.S.C. 103(c) and potential 35 U.S.C. 102(e), (f) or (g) prior art under 35 U.S.C. 103(a).

6. Claims 1, 2, 4 and 9 are rejected under 35 U.S.C. 103(a) as being unpatentable over Moore et al. in view of Lawrence et al.

As to Claim 1:

Moore et al. discloses an antenna interface circuit 54 to provide an interface between a packaged microelectronic device (die 18 and package 16) and an antenna 56 (Fig. 5; col.6: 55-col.7: 3), comprising: at least one electrical terminal 26a,b and 32a,b to couple the antenna interface circuit 54 to the microelectronic device package.

Moore et al. does not identify the components of the antenna interface circuit 54 and, accordingly, does not teach at least <u>one</u> of the following on one or more substrates: metallization forming a power amplifier impedance transformer, metallization forming a low noise amplifier input matching circuit, and metallization forming a duplexer to couple an external transmitter and an external receiver to a common antenna.

As to a power amplifier impedance transformer, Lawrence et al. discloses that for maximum power transfer to occur between a power amplifier of the transmission signals driving the feed point 107 of an antenna 106, the impedances of the power amplifier and antenna 106 must be matched, and the impedance matching is accomplished by using impedance transformer circuitry (col.9: 64-col.10: 17), then the inclusion, in Moore et al., of an external power amplifier and amplifier impedance transformer circuitry among the antenna interface components 54 of external module 14, between the signal source and the feed point of antenna 56, for matching the impedance of the power amplifier to the impedance of the antenna 56 and thereby enabling maximum signal power transfer to the antenna 56, as taught by Lawrence et al., would have been readily recognized in the pertinent art of Moore et al. for ensuring reliable performance of the radiofrequency device 10 in Fig. 5 of Moore et al.

Therefore, it would have been obvious to one of ordinary skill in the art at the time the invention was made to include the external power amplifier and power amplifier impedance transformer circuitry, taught by Lawrence et al., in the external module 14 of Moore et al., between the microelectronic die 16 and the antenna 56 of Moore et al., and to which external module 14 the terminals 26a,b connect package 16, in order to enable maximum signal power transfer of the signals from the die to the antenna and thereby ensure reliable performance of the radiofrequency device of Moore et al., as taught by Lawrence et al.

As to Claim 2, modified Moore et al. further discloses that at least one electrical terminal 32a,b is for direct connection to corresponding terminals 26a,b on a side of the

microelectronic device package that has a microelectronic die 18 mounted thereto (Figs. 1B and 5; col.3: 3-5).

As to Claim 4, modified Moore et al. further discloses metallization forming an integrated antenna 56 (the antenna metallization is shown in Fig. 5).

As to Claim 9, Moore et al. further discloses that at least one electrical terminal 22 includes a BGA (Fig. 5; col.4: 20-22 and 41-43).

7. Claims 5 and 7 are rejected under 35 U.S.C. 103(a) as being unpatentable over Moore et al. in view of Lawrence et al., as applied to claim 1, above, and further in view of Miyazaki.

As to Claims 5 and 7:

I. Moore et al. does not disclose that the components of the antenna interface circuit 54 in upper (antenna) module 14 (col.6: 55-57) also include a circuit substrate upon which the components are mounted, wherein said mounting substrate includes multiple metallization layers, including a ground plane.

II. Miyazaki et al. discloses, in Figs. 1 and 2, a radiofrequency device comprising a lower module substrate 1, on which is mounted, a microelectronic component 19 having antenna interface circuitry thereon, the substrate 1 having multiple metallization layers to accommodate the required signal, power and ground circuitry for the operation of the microelectronic component 19 and the interconnection to external antenna 129 (col.3: 45-56; col.7: 8-30).

III. Since both Moore et al. and Miyazaki et al. teach a module with antenna interface components, and since Miyazaki et al. solves the problem of providing the

signal, power and ground circuitry for the operation of the antenna interface circuit microelectronic components in a compact package by using multiple metallization layers in the package substrate, then use of such a multilayer circuit substrate would have been readily recognized in the pertinent art of Moore et al. for mounting and operating the antenna interface components in the upper (antenna) module.

IV. Therefore, it would have been obvious to one of ordinary skill in the art at the time the invention was made to modify the upper (antenna) module of Moore et al. to include in the antenna interface circuit of Moore et al., a circuit substrate having multiple metallization layers, including a ground plane, for mounting the components comprising the antenna interface circuit and providing for the components the necessary signal, power and ground circuitry in a compact substrate for the operation of the antenna interface components of Moore et al., as taught in Miyazaki et al.

8. Claim 19 is rejected under 35 U.S.C. 103(a) as being unpatentable over Moore et al. in view of Edvardsson et al.

I. Moore et al. discloses that the upper (external) module 14 contains the antenna 56 and one or more external components 54 (i.e., an antenna interface circuit) for wireless communication (col.6: 55-61 and 65-66) and further discloses at least one terminal 26a,b on the upper side of package 16 to connect the microelectronic device to the (external) module 14 and the external components 54 and antenna 56 therein but does not specify the external components 54 and, accordingly, does not teach that the terminals 26a,b connect the microelectronic device to an external low noise amplifier input matching circuit.

II. Edvardsson et al. discloses an antenna connected to an RF circuit including a duplexer circuit 401 and a low noise amplifier 405 for amplifying the received signals and matching circuitry (col.10: 33-34) for matching the power amplifier and low noise amplifier impedances with the antenna impedance (col.10: 18-39; col.4: 5-16).

III. Since modified Moore et al. teaches an antenna for receiving and emitting RF signals, and Edvardsson et al. also teaches an antenna for receiving and emitting RF signals using an RF circuit that enables both transmission (i.e., includes a power amplifier) and receiving (i.e., includes a low noise amplifier) of signals through the antenna, and Edvardsson et al. further teaches matching circuitry available for matching the impedances of the power and low noise amplifier components of the RF circuitry with the impedance of the antenna, then the use of a low noise amplifier (LNA) in the external antenna module of Moore et al. for amplifying the signals received from the antenna, and an input matching circuitry, also in the external antenna module of Moore et al., between the antenna and the LNA, for matching the LNA impedance to the antenna impedance for enabling maximum signal power transfer, as taught by Edvardsson et al., would have been readily recognized in the pertinent single antenna communication device of modified Moore et al.

IV. Therefore, it would have been obvious to one of ordinary skill in the art at the time the invention was made to further modify the package of Moore et al. to include a LNA with LNA input matching circuitry, as taught by Edvardsson et al., in the external module of Moore et al., between the microelectronic die 18 and the antenna 56 of Moore et al., and to which external module 56 the terminals 26a,b connect package 16,

in order to enable maximum signal power transfer and ensure reliable performance of the single antenna radiofrequency device of Moore et al., as taught by Edvardsson et al.

9. Claims 26 and 35 are rejected under 35 U.S.C. 103(a) as being unpatentable over Moore et al. in view of Pennisi et al.

As to Claims 26 and 35:

Moore et al. teaches that microelectronic die 18 is mounted to the upper side of package 16 using bond wires 20. Moore et al. does not teach mounting die 18 using flip chip techniques.

Pennisi et al. discloses a radio frequency device 10 (col.2: 49-54) wherein microelectronic die 16 is mounted to the upper side of package 11 using bond wires 20. However, Pennisi et al. discloses that die 16 may also be mounted to the upper side of package 11 using flip chip techniques (col.3: 20-22).

Since both Moore et al. and Pennisi et al. are both in the art of radio frequency electronics packaging, then the use of flip chip techniques to bond the microelectronic die is mounted to the upper side of package, as taught by Pennisi et al., would have been readily recognized in the pertinent art of Moore et al.

Therefore, it would have been obvious to one of ordinary skill in the art at the time the invention was made to use flip chip techniques instead of wire bonding to mount the microelectronic device to the upper side of the package in Moore et al., as taught by Pennisi et al. in order to reduce the electrical and physical signal path length between the die and the package, thereby reducing signal propagation time and parasitic inductance in the radio frequency device of Moore et al.

10. Claim 36 is rejected under 35 U.S.C. 103(a) as being unpatentable over Moore et al. in view of Lawrence et al.

I. Moore et al. discloses that die 18 on package 16 includes analog circuitry for conditioning the receiving or emitting communications signals but does not specify the circuitry and, accordingly, does not teach that package 16 includes power amplifier impedance transformer circuitry.

II. Lawrence et al. discloses that for maximum power transfer to occur between a power amplifier of the transmission signals driving the feed point 107 of an antenna 106, the impedances of the power amplifier and antenna 106 must be matched, and the impedance matching is accomplished by using impedance transformer circuitry (col.9: 64-col.10: 17), then the inclusion, in Moore et al., of impedance transformer circuitry on package 16, between the signal source (i.e., the microelectronic die having a power amplifier among the analog conditioning circuits included therein) and the feed point of antenna 56, for matching the impedance of the power amplifier to the impedance of the antenna 56 and thereby enabling maximum signal power transfer to the antenna 56, as taught by Lawrence et al., would have been readily recognized in the pertinent art of Moore et al. for ensuring reliable performance of the radiofrequency device 10 in Fig. 5 of Moore et al.

III. Therefore, it would have been obvious to one of ordinary skill in the art at the time the invention was made to include the power amplifier impedance transformer circuitry, taught by Lawrence et al., in the package of Moore et al., between the microelectronic die and the antenna in Moore et al., in order to enable maximum signal

power transfer of the signals from the die to the antenna and thereby ensure reliable performance of the radiofrequency device of Moore et al., as taught by Lawrence et al.

11. Claims 37 and 38 are rejected under 35 U.S.C. 103(a) as being unpatentable over Moore et al. in view of Lawrence et al., as applied to Claim 36, above, and further in view of Edvardsson et al.

As to Claim 37:

I. Modified Moore et al. discloses a single antenna 56 on module 14 for receiving and emitting signals (col.6: 59-61 and 65-66), and that die 18 on package 16 includes analog circuitry for conditioning the receiving or emitting communications signals (col.6: 67-col.7: 3) but does not specify the circuitry and, accordingly, does not teach that package 16 includes low noise amplifier input matching circuitry.

II. Edvardsson et al. discloses an antenna connected to an RF circuit including a duplexer circuit 401 and a low noise amplifier 405 for amplifying the received signals and matching circuitry (col.10: 33-34) for matching the power amplifier and low noise amplifier impedances with the antenna impedance (col.10: 18-39; col.4: 5-16).

III. Since modified Moore et al. teaches an antenna for receiving and emitting RF signals, and Edvardsson et al. also teaches an antenna for receiving and emitting RF signals using an RF circuit that enables both transmission (i.e., includes a power amplifier) and receiving (i.e., includes a low noise amplifier) of signals through the antenna, and Edvardsson et al. further teaches matching circuitry available for matching the impedances of the power and low noise amplifier components of the RF circuitry with the impedance of the antenna, then the use of a low noise amplifier (LNA) for

amplifying the signals received from the antenna, and an input matching circuitry on the package, between the antenna and the LNA, for matching the LNA impedance to the antenna impedance for enabling maximum signal power transfer, as taught by Lawrence et al. and Edvardsson et al., would have been readily recognized in the pertinent single antenna communication device of modified Moore et al.

IV. Therefore, it would have been obvious to one of ordinary skill in the art at the time the invention was made to further modify the package of Moore et al. to include a LNA with LNA input matching circuitry, as taught by Edvardsson et al., between the microelectronic die and the antenna of Moore et al. in order to enable maximum signal power transfer and ensure reliable performance of the single antenna radiofrequency device of Moore et al., as taught by Lawrence et al. and Edvardsson et al.

As to Claim 38:

I. Modified Moore et al. discloses a single antenna 56 on module 14 for receiving and emitting signals (col.6: 59-61 and 65-66), and that die 18 on package 16 includes analog circuitry for conditioning the receiving or emitting communications signals (col.6: 67-col.7: 3) but does not specify the circuitry and, accordingly, does not teach that package 16 includes duplexer circuitry to allow a wireless transmitter and a wireless receiver within the microelectronic device (col.6: 67-col.7: 12) to share the common antenna 56.

II. Edvardsson et al. discloses an antenna connected to an RF circuit including a duplexer circuit 401 for separating the transmitting and receiving RF signals and couples the received antenna signals to other elements of the RF circuit, i.e., filter 404

and LNA 405 and couples the transmitting signals from the filter 404 and power amplifier to the antenna (col.10: 18-32; col.4: 5-16).

III. Since modified Moore et al. has a single antenna for transmitting and receiving signals, an LNA for amplifying the receiving signals and a power amplifier for the transmitting signals, then the use of a duplexer for separating the transmitting and receiving signals and coupling those signals between the antenna and the respective power and low noise amplifiers, as taught by Edvardsson et al., would have been readily recognized in the single antenna radiofrequency device of Moore et al.

IV. Therefore, it would have been obvious to one of ordinary skill in the art at the time the invention was made to further modify the package of Moore et al. to include duplexer circuitry in order to allow a wireless transmitter and a wireless receiver within the microelectronic device to share the common antenna in Moore et al., as taught by Edvardsson et al.

12. Claims 18 and 39 are rejected under 35 U.S.C. 103(a) as being unpatentable over Moore et al. in view of Lawrence et al.

As to Claims 18 and 39:

I. Moore et al. discloses that the upper (external) module 14 contains the antenna 56 and one or more external components 54 (i.e., an antenna interface circuit) for wireless communication (col.6: 55-61 and 65-66) and further discloses at least one terminal 26a,b on the upper side of package 16 to connect the microelectronic device to the (external) module 14 and the external components 54 and antenna 56 therein but does not specify the external components 54 and, accordingly, does not teach that the

terminals 26a,b connect the microelectronic device to an external power amplifier impedance transformer.

II. Lawrence et al. discloses that for maximum power transfer to occur between a power amplifier of the transmission signals driving the feed point 107 of an antenna 106, the impedances of the power amplifier and antenna 106 must be matched, and the impedance matching is accomplished by using impedance transformer circuitry (col.9: 64-col.10: 17), then the inclusion, in Moore et al., of an external power amplifier and amplifier impedance transformer circuitry among the external components 54 of external module 14, between the signal source and the feed point of antenna 56, for matching the impedance of the power amplifier to the impedance of the antenna 56 and thereby enabling maximum signal power transfer to the antenna 56, as taught by Lawrence et al., would have been readily recognized in the pertinent art of Moore et al. for ensuring reliable performance of the radiofrequency device 10 in Fig. 5 of Moore et al.

III. Therefore, it would have been obvious to one of ordinary skill in the art at the time the invention was made to include the external power amplifier and power amplifier impedance transformer circuitry, taught by Lawrence et al., in the external module 14 of Moore et al., between the microelectronic die 16 and the antenna 56 of Moore et al., and to which external module 14 the terminals 26a,b connect package 16, in order to enable maximum signal power transfer of the signals from the die to the antenna and thereby ensure reliable performance of the radiofrequency device of Moore et al., as taught by Lawrence et al.

13. Claim 40 is rejected under 35 U.S.C. 103(a) as being unpatentable over Moore et al. in view of Lawrence et al, as applied to Claim 39, above, and further in view of Edvardsson et al.

I. Moore et al. discloses that the upper (external) module 14 contains the antenna 56 and one or more external components 54 (i.e., an antenna interface circuit) for wireless communication (col.6: 55-61 and 65-66) and further discloses at least one terminal 26a,b on the upper side of package 16 to connect the microelectronic device to the (external) module 14 and the external components 54 and antenna 56 therein but does not specify the external components 54 and, accordingly, does not teach that the terminals 26a,b connect the microelectronic device to an external low noise amplifier input matching circuit.

II. Edvardsson et al. discloses an antenna connected to an RF circuit including a duplexer circuit 401 and a low noise amplifier 405 for amplifying the received signals and matching circuitry (col.10: 33-34) for matching the power amplifier and low noise amplifier impedances with the antenna impedance (col.10: 18-39; col.4: 5-16).

III. Since modified Moore et al. teaches an antenna for receiving and emitting RF signals, and Edvardsson et al. also teaches an antenna for receiving and emitting RF signals using an RF circuit that enables both transmission (i.e., includes a power amplifier) and receiving (i.e., includes a low noise amplifier) of signals through the antenna, and Edvardsson et al. further teaches matching circuitry available for matching the impedances of the power and low noise amplifier components of the RF circuitry with the impedance of the antenna, then the use of a low noise amplifier (LNA) in the

external antenna module of Moore et al. for amplifying the signals received from the antenna, and an input matching circuitry, also in the external antenna module of Moore et al., between the antenna and the LNA, for matching the LNA impedance to the antenna impedance for enabling maximum signal power transfer, as taught by Lawrence et al. and Edvardsson et al., would have been readily recognized in the pertinent single antenna communication device of modified Moore et al..

V. Therefore, it would have been obvious to one of ordinary skill in the art at the time the invention was made to further modify the package of Moore et al. to include a LNA with LNA input matching circuitry, as taught by Edvardsson et al., in the external module of Moore et al., between the microelectronic die 18 and the antenna 56 of Moore et al., and to which external module 56 the terminals 26a,b connect package 16, in order to enable maximum signal power transfer and ensure reliable performance of the single antenna radiofrequency device of Moore et al., as taught by Lawrence et al. and Edvardsson et al.

14. Claim 20 is rejected under 35 U.S.C. 103(a) as being unpatentable over Moore et al. in view of Edvardsson et al.

I. Moore et al. discloses that the upper (external) module 14 contains the antenna 56 and one or more external components 54 (i.e., an antenna interface circuit) for wireless communication (col.6: 55-61 and 65-66) and further discloses at least one terminal 26a,b on the upper side of package 16 to connect the microelectronic device to the (external) module 14 and the external components 54 and antenna 56 therein but does not specify the external components 54 and, accordingly, does not teach that the

terminals 26a,b connect the microelectronic device to an external power amplifier impedance transformer. but does not specify the circuitry and, accordingly, does not teach that the antenna interface circuit 54 includes duplexer circuitry to allow a wireless transmitter and a wireless receiver within the microelectronic device (col.6: 67-col.7: 12) to share the common antenna 56.

II. Edvardsson et al. discloses an antenna connected to an RF circuit including a duplexer circuit 401 for separating the transmitting and receiving RF signals and couples the received antenna signals to other elements of the RF circuit, i.e., filter 404 and LNA 405 and couples the transmitting signals from the filter 404 and power amplifier to the antenna (col.10: 18-32; col.4: 5-16).

III. Since modified Moore et al. has a single antenna for transmitting and receiving signals, an LNA for amplifying the receiving signals and a power amplifier for the transmitting signals, then the use of a duplexer for separating the transmitting and receiving signals and coupling those signals between the antenna and the respective power and low noise amplifiers, as taught by Edvardsson et al., would have been readily recognized in the single antenna radiofrequency device of Moore et al.

IV. Therefore, it would have been obvious to one of ordinary skill in the art at the time the invention was made to further modify the antenna interface circuit of Moore et al. to include duplexer circuitry in order to allow a wireless transmitter and a wireless receiver within the microelectronic device to share the common antenna in Moore et al., as taught by Edvardsson et al.

15. Claim 21 is rejected under 35 U.S.C. 103(a) as being unpatentable over Moore et al. in view of Edvardsson et al. and Lawrence et al.

Ia. Moore et al. discloses that the upper (external) module 14 contains the antenna 56 and one or more external components 54 (i.e., an antenna interface circuit) for wireless communication (col.6: 55-61 and 65-66) and further discloses at least one terminal 26a,b on the upper side of package 16 to connect the microelectronic device to the (external) module 14 and the external components 54 and antenna 56 therein but does not specify the external components 54 and, accordingly, does not teach that the terminals 26a,b connect the microelectronic device to an external power amplifier impedance transformer. but does not specify the circuitry and, accordingly, does not teach that the antenna interface circuit 54 includes power amplifier impedance transformer circuitry, low noise amplifier (LNA) input matching circuitry, and duplexer circuitry to allow a wireless transmitter and a wireless receiver within the microelectronic device (col.6: 67-col.7: 12) to share the common antenna 56.

Ib. Edvardsson et al. discloses (col.4: 5-16) that an antenna interface circuit for a transceiver antenna includes a power amplifier and Lawrence et al. discloses (col.9: 64-col.10: 17) that for maximum power transfer to occur between a power amplifier of the transmission signals driving the feed point 107 of an antenna 106, the impedances of the power amplifier and antenna 106 must be matched, and the impedance matching is accomplished by using impedance transformer circuitry, then the inclusion, in Moore et al., of an external power amplifier and amplifier impedance transformer circuitry among the external components 54 (antenna interface circuit) of external module 14, between

the signal source and the feed point of antenna 56, for matching the impedance of the power amplifier to the impedance of the antenna 56 and thereby enabling maximum signal power transfer to the antenna 56, as taught by Lawrence et al. and Edvardsson et al., would have been readily recognized in the pertinent art of Moore et al. for ensuring reliable performance of the radiofrequency device 10 in Fig. 5 of Moore et al.

Ic. Therefore, it would have been obvious to one of ordinary skill in the art at the time the invention was made to include the external power amplifier and power amplifier impedance transformer circuitry, taught by Edvardsson et al. and Lawrence et al., in the antenna interface circuit in external module 14 of Moore et al., between the microelectronic die 16 and the antenna 56 of Moore et al., and to which external module 14 the terminals 26a,b connect package 16, in order to enable maximum signal power transfer of the signals from the die to the antenna and thereby ensure reliable performance of the radiofrequency device of Moore et al., as taught by Lawrence et al.

IIa. Edvardsson et al. discloses an antenna connected to an RF circuit including a duplexer circuit 401 and a low noise amplifier 405 for amplifying the received signals and matching circuitry (col.10: 33-34) for matching the power amplifier and low noise amplifier impedances with the antenna impedance (col.10: 18-39; col.4: 5-16).

IIb. Since modified Moore et al. teaches an antenna for receiving and emitting RF signals, and Edvardsson et al. also teaches an antenna for receiving and emitting RF signals using an RF circuit that enables both transmission (i.e., includes a power amplifier) and receiving (i.e., includes a low noise amplifier) of signals through the antenna, and Edvardsson et al. further teaches matching circuitry available for matching

the impedances of the power and low noise amplifier components of the RF circuitry with the impedance of the antenna, then the use of a low noise amplifier (LNA) for amplifying the signals received from the antenna, and an input matching circuitry on the package, between the antenna and the LNA, for matching the LNA impedance to the antenna impedance for enabling maximum signal power transfer, as taught by Lawrence et al. and Edvardsson et al., would have been readily recognized in the pertinent single antenna communication device of modified Moore et al.

IIc. Therefore, it would have been obvious to one of ordinary skill in the art at the time the invention was made to further modify the antenna interface circuit of Moore et al. to include a LNA with LNA input matching circuitry, as taught by Edvardsson et al., between the microelectronic die and the antenna of Moore et al. in order to enable maximum signal power transfer and ensure reliable performance of the single antenna radiofrequency device of Moore et al., as taught by Lawrence et al. and Edvardsson et al.

IIIa. Modified Moore et al. discloses a single antenna 56 on module 14 for receiving and emitting signals (col.6: 59-61 and 65-66), and that die 18 on package 16 includes analog circuitry for conditioning the receiving or emitting communications signals (col.6: 67-col.7: 3) but does not specify the circuitry and, accordingly, does not teach that package 16 includes duplexer circuitry to allow a wireless transmitter and a wireless receiver within the microelectronic device (col.6: 67-col.7: 12) to share the common antenna 56.

IIIb. Edvardsson et al. discloses an antenna connected to an RF circuit including a duplexer circuit 401 for separating the transmitting and receiving RF signals and couples the received antenna signals to other elements of the RF circuit, i.e., filter 404 and LNA 405 and couples the transmitting signals from the filter 404 and power amplifier to the antenna (col.10: 18-32; col.4: 5-16).

IIIc. Since modified Moore et al. has a single antenna for transmitting and receiving signals, an LNA for amplifying the receiving signals and a power amplifier for the transmitting signals, then the use of a duplexer for separating the transmitting and receiving signals and coupling those signals between the antenna and the respective power and low noise amplifiers, as taught by Edvardsson et al., would have been readily recognized in the single antenna radiofrequency device of Moore et al.

IIId. Therefore, it would have been obvious to one of ordinary skill in the art at the time the invention was made to further modify the package of Moore et al. to include duplexer circuitry in order to allow a wireless transmitter and a wireless receiver within the microelectronic device to share the common antenna in Moore et al., as taught by Edvardsson et al.

16. Claim 22 is rejected under 35 U.S.C. 103(a) as being unpatentable over Moore et al. in view of Miyazaki et al.

I. Moore et al. does not disclose that the components of the antenna interface circuit 54 in upper (antenna) module 14 (col.6: 55-57) also include a circuit substrate upon which the components are mounted, said mounting substrate including multiple metallization layers.

II. Miyazaki et al. discloses, in Figs. 1 and 2, a radiofrequency device comprising a lower module substrate 1, on which is mounted, a microelectronic component 19 having antenna interface circuitry thereon, the substrate 1 having multiple metallization layers to accommodate the required signal, power and ground circuitry for the operation of the microelectronic component 19 and the interconnection to external antenna 129 (col.3: 45-56; col.7: 8-30).

III. Since both Moore et al. and Miyazaki et al. teach a module with antenna interface components, and since Miyazaki et al. solves the problem of providing the signal, power and ground circuitry for the operation of the antenna interface circuit microelectronic components in a compact package by using multiple metallization layers in the package substrate, then use of such a multilayer circuit substrate would have been readily recognized in the pertinent art of Moore et al. for mounting and operating the antenna interface components in the upper (antenna) module.

IV. Therefore, it would have been obvious to one of ordinary skill in the art at the time the invention was made to modify the upper (antenna) module of Moore et al. to include in the antenna interface circuit of Moore et al., a circuit substrate having multiple metallization layers for mounting the components comprising the antenna interface circuit and providing for the components the necessary signal, power and ground circuitry in a compact substrate for the operation of the antenna interface components of Moore et al., as taught in Miyazaki et al.

Allowable Subject Matter

17. Claims 11-16, 29-32 and 41-43 have been allowed.

18. Claims 3, 6, 8, 10, 23, 25 and 28 are objected to as being dependent upon a rejected base claim, but would be allowable if rewritten in independent form including all of the limitations of the base claim and any intervening claims.

Conclusion

19. Any inquiry concerning this communication or earlier communications from the examiner should be directed to John B. Vigushin whose telephone number is 571-272-1936. The examiner can normally be reached on 8:30AM-5:00PM Mo-Fri.

If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, Kamand Cuneo can be reached on 571-272-1957. The fax phone number for the organization where this application or proceeding is assigned is 703-872-9306.

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John B. Vigushin
John B. Vigushin
Primary Examiner
Art Unit 2841

jbv
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